

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements in or relating to Air Pumps and the like.

I, REGINALD DONOVAN BOYCE, of 306, London Road, Westcliffe-on-Sea, in the County of Essex, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to multiple cylinder reciprocating pumps adapted to be driven by means of a single rotary shaft.

In accordance with the present invention the outer ends of the pistons are pivotally connected with corresponding points on a swash plate, said swash plate being acted upon by a series of rollers carried by and at unequal distances from, a plate mounted upon the driving shaft, at right angles to the axis thereof.

Preferably the rollers are mounted in ball bearings on a series of pillars of unequal length disposed around the periphery of a flywheel or the like, and parallel with the axis thereof, and said rollers may be adapted to roll on tracks formed on a circumferential ridge on the swash plate. Also the pistons may be pivotally connected with the swash-plate by means of short connecting rods having ball and socket joints, and the swash plate may be centrally pivoted by a ball and socket joint with a point on the pump framework on the axis of the driving shaft.

In one form of the invention four pump cylinders are cast integral with a base plate so that the axes of the cylinders are in a circle and are perpendicular to the plane of the base plate. Each cylinder is provided with a delivery port, controlled by a non-return valve, and the outlets from the delivery valves are connected with a common delivery pipe, whilst each cylinder may be provided with an inlet valve. In each cylinder is a trunk piston having a cup-leather or

piston-ring packing, and provided at its outer end with the socket portion of a ball and socket joint, all the pistons being of equal length. A boss is formed in the centre of the base plate and is provided at its outer end with the ball portion of a ball and socket joint.

A swash plate connected at its centre with the central lug on the base plate by means of a ball and socket joint is formed on that side adjacent to the cover plate with a series of socket portions of ball and socket joints, said series corresponding in position and number with the cylinders. Each of said socket portions is connected with the socket portion on the corresponding piston by means of a short connecting rod formed at each end with the ball portion of a ball and socket joint.

A driving shaft, mounted to rotate in a bearing in an extension of the base plate and provided with a collar and ball thrust washer, is coaxial with the circle containing the axes of the pump cylinders and carries on that end adjacent to the base plate a disc or flywheel.

Spaced at equal angular intervals adjacent the circumference of the flywheel are four pillars, one pair of diametrically opposite pillars being at equal length and the remaining two being respectively longer and shorter by equal amounts than said equal pair.

The outer end of each pillar is provided with a friction roller, preferably mounted on ball bearings, and having its axis disposed radially relatively to the driving shaft so as to be adapted to roll on a track formed on a circumferential ridge on the swash plate. Three tracks are provided on the ridge one parallel with the surface of the plate with which the rollers of the two equal pillars are

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adapted to contact and one on each side of the first track, and at an angle thereto.

In order to operate the pump, the driving shaft is rotated by any desired means, *e.g.* manually and the swash plate is thus caused to rock with a circular wave motion and successively to force forward and afterwards to draw back the pistons in the cylinders.

The number of working strokes of the

pump, as a whole, per revolution of the driving shaft being equal to the number of cylinders, it follows that a large volume of air may be rapidly pumped by the apparatus. 15

Dated the 5th day of January, 1921.

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## COMPLETE SPECIFICATION.

### Improvements in or relating to Air Pumps and the like.

I, REGINALD DONOVAN BOYCE, of 306, London Road, Westcliffe-on-Sea, in the County of Essex, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to multiple cylinder reciprocating pumps adapted to be driven by means of a single rotary shaft through swash plate mechanism, the several pistons being driven from the swash plate through connecting rods provided at their opposite ends with universal joints, whilst the swash plate is operated by rollers carried by the driving shaft and has for its object to provide a pump of simple construction which is easy to operate and which will give a steady delivery of increased volume as compared with other pumps of equal size.

According to this invention the rollers are mounted on a series of pillars of unequal length disposed around the circumference of a fly wheel or the like and parallel with the axis thereof, said rollers being adapted to roll on tracks formed on a circumferential ridge on the swash plate.

The preferred form of the invention will be described with reference to the accompanying drawings in which Figure 1 is an end elevation and Figure 2 a plan of a pump, whilst Figure 3 is a sectional side elevation substantially on the line 3—3 Figure 2, and Figure 4 is a side elevation of a detail.

Four pump cylinders *a*... are cast integral with a base plate *b* so that the axes of the cylinders *a* are in a circle and are perpendicular to the plane of the base plate *b*. Each cylinder *a* is pro-

vided with a delivery port *c*, controlled by a non-return valve *d*, and the outlets *c* from the delivery valves *d* are connected with a common delivery pipe *f* whilst each cylinder *a* is provided with an inlet passage *g*. In each cylinder *a* is a solid piston *h* having a cup-leather *i* or a piston-ring packing, and provided at its outer end with the socket portion *j* of a ball and socket joint *k, j*, all the pistons *a*... being of equal length. A boss *l* is formed in the centre of the base plate *b* and is provided at its outer end with the ball portion *m* of a ball and socket joint *m, n*. 65 70 75

A swash plate *o* connected at its centre with the central boss *l* on the base plate *b* by means of the ball and socket joint *m, n* is formed on that side adjacent to the base plate *b* with a series of socket portions *p*... of ball and socket joints *q, p*, said series corresponding in position and number with the cylinders *a*. Each of said socket portions *p* is connected with the socket portion *j* on the corresponding piston *h* by means of a short connecting rod *r* formed at each end with the ball portion *k* and *q* respectively of a ball and socket joint *k, j* and *q, p* respectively. 80 85 90

The base plate *b* is carried by a sole plate *s* and strengthened by buttress ribs *t, t* and a driving shaft *u* mounted to rotate in a bearing *v* carried by the sole plate *s* and provided with a ball thrust bearing *w*, is coaxial with the circle containing the axes of the pump cylinders *a* and carries on that end adjacent to the base plate *b* a disc or flywheel *x*. 95 100

Spaced at equal angular intervals adjacent to the circumference of the flywheel *x* are four pillars *y<sup>1</sup>, y<sup>2</sup>, y<sup>3</sup>, y<sup>4</sup>*, one pair of diametrically opposite pillars *y<sup>2</sup>, y<sup>4</sup>* being of equal length and the remain- 105

ing two  $y^1$  and  $y^3$  being respectively longer and shorter by equal amounts than said equal pair  $y^2$  and  $y^4$ .

The outer end of each pillar  $y^1$ ,  $y^2$ ,  $y^3$ ,  $y^4$  is provided with a friction roller  $z^1$ ,  $z^2$ ,  $z^3$ ,  $z^4$  respectively, preferably mounted on ball bearings, not shown, and having its axis disposed radially relatively to the driving shaft  $u$  so as to be adapted to roll on a track formed on a circumferential ridge 9 on the swash plate  $o$ . Three tracks 10, 11, 12 are provided on the ridge 9, one 10 parallel with the surface of the plate  $o$  with which the rollers  $z^2$ ,  $z^4$  of the two equal pillars  $y^2$ ,  $y^4$  are adapted to contact and one 11 or 12 on each side of the first track 10, and at an angle thereto, as shewn in Fig. 3, with which the rollers  $z^1$ , and  $z^3$  of the pillars  $y^1$  and  $y^3$  respectively are adapted to contact.

In order to operate the pump, the driving shaft  $u$  is rotated by any desired means, *e.g.* manually, by a crank handle  $w^1$ , and the swash plate  $o$  is thus caused to rock with a circular wave motion and successively to force forward and afterwards to draw back the pistons  $h$  in the cylinders  $a$ .

In order to restrain any tendency of the swash plate  $o$  to rotate about the axis of the driving shaft  $u$ , said swash plate is provided at each side with a radially projecting pin 13 carrying an antifricition roller 14 adapted to engage within a track such as is shewn at 15 Figure 4, the track 15 being carried by a bracket 16 bolted to the sole plate  $s$ .

In order to lubricate the pistons  $h$  within the cylinders  $a$ , each is formed with an axial passage 17 closed towards one end by a grub screw 18 in a radial aperture and at the other end by a screw 19, which, with a head or cap 20 holds the cap leather  $i$  in place, said axial passage 17 communicating by a radial passage 21 with a helical groove 22 in the surface of the piston  $h$ . A wick, not shown, is laid in the groove 22 and led through the passage 21 to the passage 17 and the latter is charged with oil through the aperture which is normally closed by the grub screw 18, so that oil is constantly fed to the wick in the groove 22.

and the piston  $h$  and cylinder  $a$  are efficiently lubricated.

The number of working strokes of the pump, as a whole, per revolution of the driving shaft  $u$  being equal to the number of cylinders, it follows that a large volume of air may be rapidly pumped by the apparatus.

By mounting the base plate  $b$  to rotate in bearings and forming it as a gear wheel or belt pulley, or by mounting the base plate  $b$  cylinders  $a$  and associated parts coaxially on the end of a shaft, the apparatus may be used as variable speed transmission mechanism, the gear ratio depending upon the rate at which air is allowed to escape from the common delivery pipe  $j$ .

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A pump of the kind hereinbefore set forth wherein the rollers are mounted on a series of pillars of unequal length disposed around the circumference of a fly wheel or the like, and parallel with the axis thereof, and wherein said rollers are adapted to roll on tracks formed on a circumferential ridge on the swash plate.

2. A pump, as claimed in Claim 1 wherein means are provided for restraining any tendency of the swash plate to rotate about the axis of the driving shaft, substantially as set forth.

3. A pump, as claimed in any of the preceding claims adapted for use as variable speed transmission mechanism, substantially as set forth.

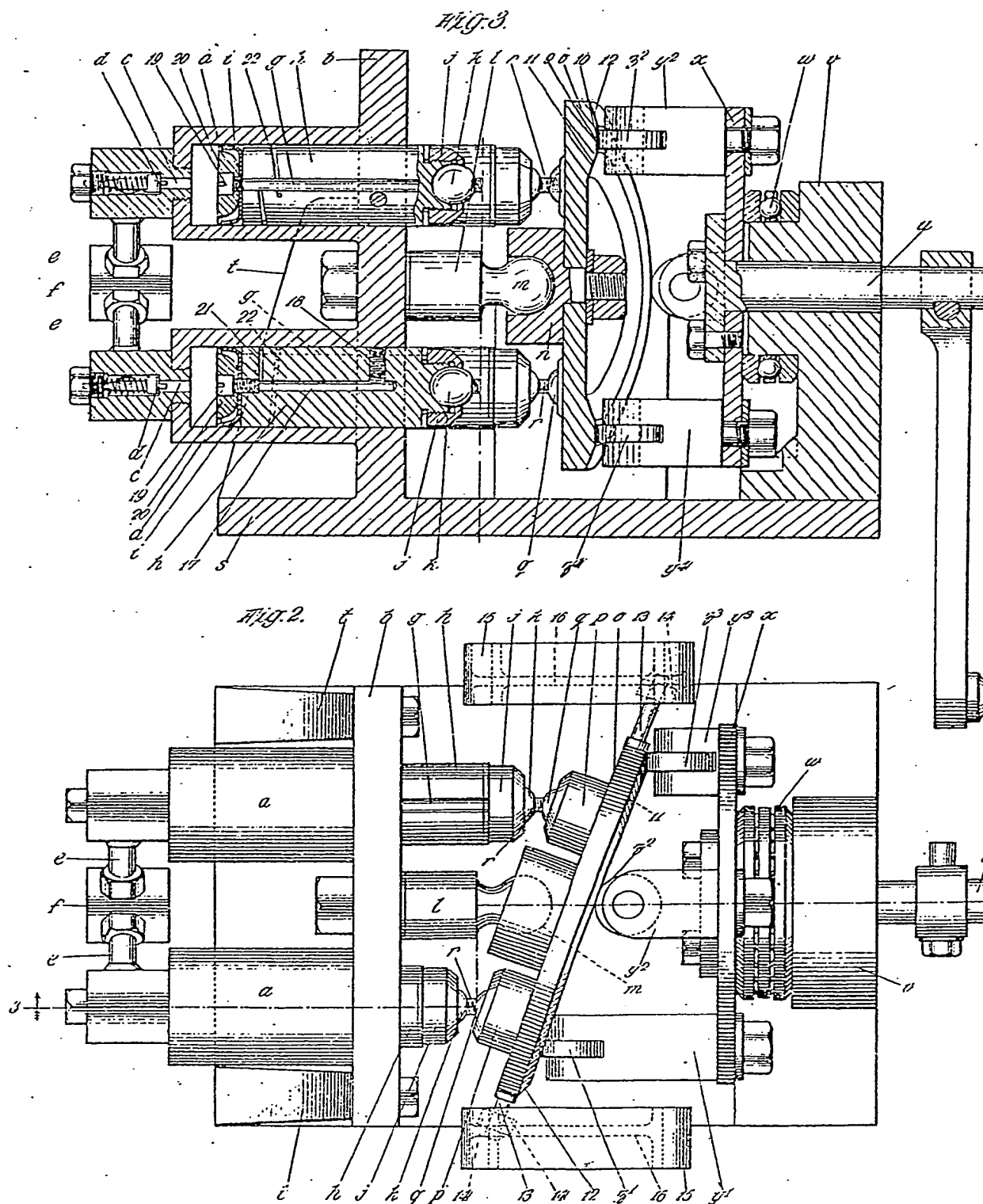
4. A pump constructed, arranged and adapted to operate substantially as hereinbefore set forth.

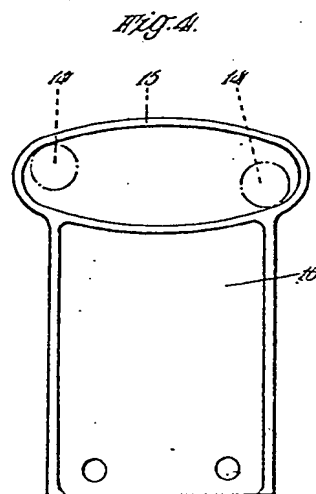
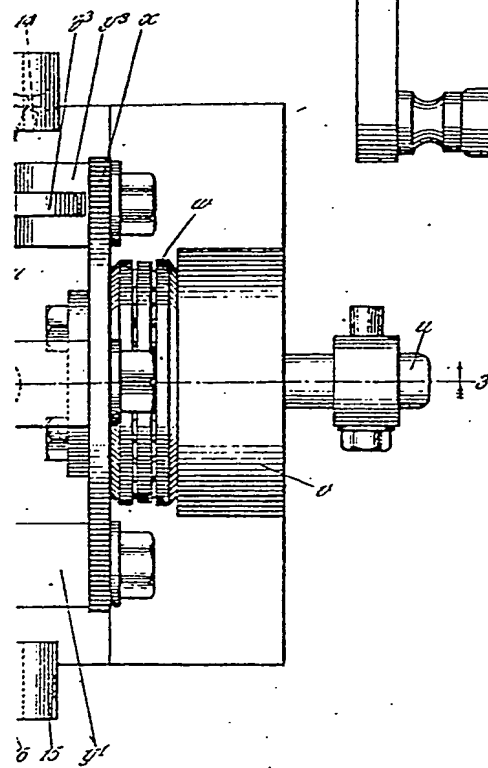
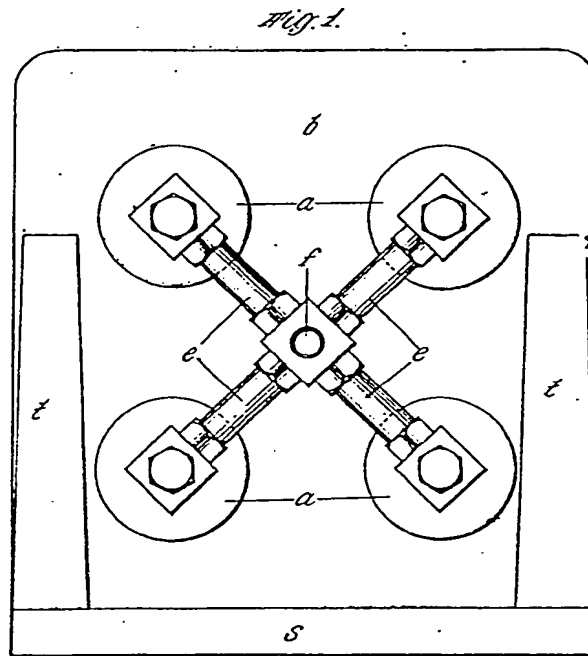
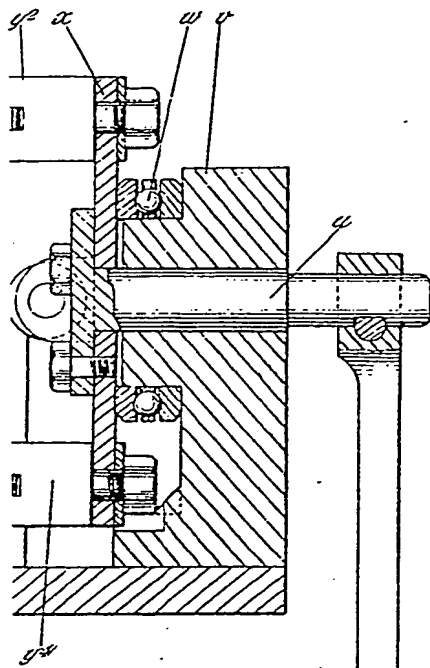
5. A pump constructed and arranged substantially as hereinbefore set forth with reference to the accompanying drawings.

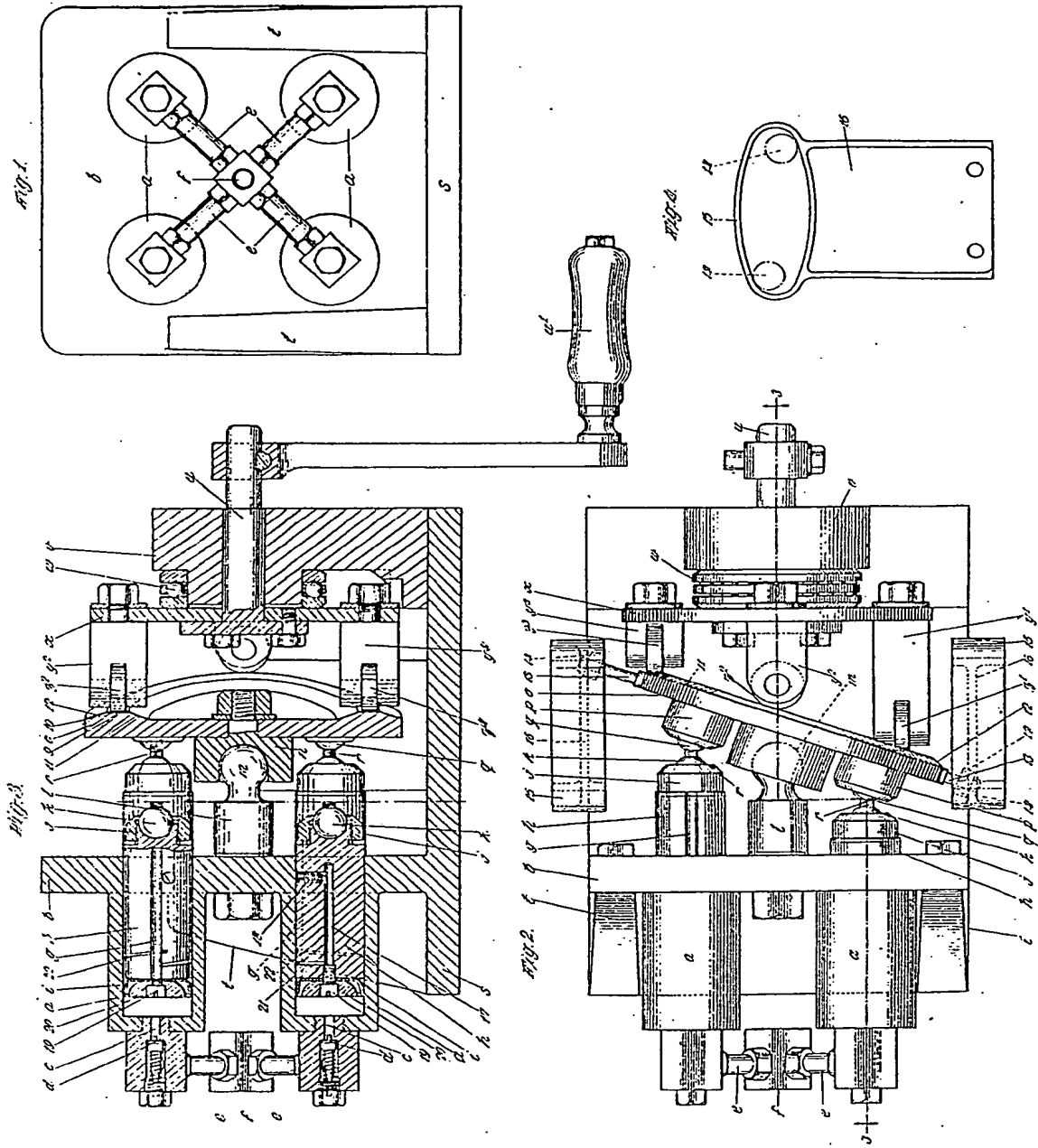
Dated the 22nd day of March, 1921.

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[This Drawing is a reproduction of the Original on a reduced scale.]







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